CLAIMS

1. A method for providing communications in a conduit between a control station and a communication device in the vicinity of a tool, said tool being electrically powered through a cable, within the conduit, said method comprising the steps of: generating a signal representative of a data message to be send; adding said signal to the power waveform on the cables; separating said signal from the power waveform on the cables; decoding said separated signal; and reconstituting said data message.

2. A method, according to claim 1, including the steps of: originating said data message at said control station; and receiving said data message at said device.

3. A method, according to claim 1 or claim 2, including the steps of: originating said data message at said device; and receiving said data message at said control station.

4. A method, according to claim 3, including the steps of employing a first type of data message for sending instructions from said control station, and employing a second type of data message for sending reports from said device to said control station.

5. A method, according to claim 4, including the steps of: employing a plurality of tools, each in the vicinity of a respective device, in said conduit; at said control station, including, in said first type of data message, a device address portion indicative of the identity of the device to which an instruction is addressed; sending said first type of data message to all of the plurality of devices; decoding said address portion at each of the plurality of devices; and a particular one of said plurality of devices responding to the instruction only if the address portion of the first type of data message is indicative of the first type of data message being addressed to that particular one of said plurality of devices.

6. A method, according to claim 4, including the steps of: employing a plurality of tools, each in the vicinity of a respective device, in said conduit; at said control station, including, in said first type of data message, a device address portion indicative of the identity of a plurality of addressed devices to which an instruction is addressed; sending said first type of data message to all of the plurality of devices; decoding said address portion at each of the plurality of devices; and all of said plurality of the addressed devices responding to the instruction.

7. A method, according to claim 4, or according claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the steps of: employing a plurality of tools, each in the vicinity of a respective device, in said conduit; at one of said devices, including, in said second type of data message, a report address portion indicative of the identity of the device from which a report originates; decoding said report address portion at said control station; and attributing the report to that one of said plurality of devices indicated by the report address.

8. A method, according to claim 4, according to claim 7, or according to claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the step of a device providing a second type of digital message without reception of a first type of digital message.

9. A method, according to claim 4, 7 or 8, or according to claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the step of causing a device, from among said plurality of devices, to provide a report only after that particular device has received an instruction to provide a report.

10. A method, according to any one of claims 4, 7, 8 or 9, or according to claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the step of employing said second type of digital message for diagnostic purposes.

11. A method, according to any one of claims 4, 7, 8 or 9, or according to claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the step of employing said second type of digital message for tuning during a power up sequence.

12. A method, according to any one of claims 4, 7, 8 or 9, or according to claim 5 or claim 6 when claim 5 or claim 6 is dependent upon claim 4, including the step of employing said second type of digital message for indicating a reading from a sensor.

13. A method, according to any one of the preceding claims, including the steps of: including, in each sent each data message, an error detection portion containing error detection information; and examining said error detection portion in each received data message to determine the digital integrity of the message.

14. A method, according to claim 13, including the step of employing, in said error detection portion, error detection information capable of allowing for correction of one or more errors.

15. A method, according to claim 13 or claim 14, wherein said error detection information includes a checksum.

16. A method, according to any one of the preceding claims, for use where said cable comprises at least two phases, said method including the step of adding said signal to at least one of said phases.

17. A method, according to any one of the preceding claims, including the steps of: providing a three phase cable to power the tool within the conduit; creating a star point in the vicinity of the tool; and coupling signals from the control station to said device and signals from said device to the control station through said star point.

18. A method, according to claim 17, including the step of creating said star point by joining the three phase cables after passage through the tool

19. A method, according to claim 17 or claim 18, including the steps of: providing a power supply for said device; coupling the power supply to at least one of the cables; and coupling the power supply to said device via the star point.

20. A method, according to any one of the preceding claims, wherein said conduit is the well bore within a hydrocarbon production well and wherein said control station is a surface station.

21. A method, according to any one of the preceding claims, including the steps of: grounding said device to a common ground; and grounding the control station to said common ground.

22. A method, according to claim 21 wherein said common ground comprises a conductive element within the well bore.

23. A method, according to claim 22, wherein said conductive element comprises well bore casing.

24. A method, according to claim 22, wherein said conductive element comprises tubing extending in said well bore.

25. A method, according to any one of the preceding claims, including the step of employing, as said signal representative of a data message, a frequency shift keyed signal.

26. A method, according to claim 25, including the step of separating the frequency shift keyed signal from the power waveform on the cable by employing one or more frequency filters.

27. A method, according to claim 26, wherein said one or more frequency filters includes at least one of: a low pass filter; a high pass filter; and a band pass filter.

28. A method, according to any one of claims 25, 26 or 27, including the step of tuning by: selecting one set of frequencies for said frequency shift keyed signal; transmitting a test message using said one set of frequencies; if said transmission of said test message is adequate, retaining said one set of frequencies as operating frequencies; and if said transmission of said test message is inadequate, selecting a another set of frequencies as said one set of frequencies.

29. A method, according to claim 28, including the step of selecting a first spaced pair of frequencies as said one set of frequencies; and selecting a second spaced pair of frequencies, spaced from said first spaced pair of frequencies, as said another set of frequencies.

30. A method, according to claim 29, wherein said second spaced pair of frequencies is higher in frequency than said first spaced pair of frequencies.

31. A method, according to claim 29, wherein said second spaced pair of frequencies is lower in frequency than said first spaced pair of frequencies.

32. An apparatus for providing communications in a conduit between a control station and a communication device in the vicinity of a tool, said tool being electrically powered through a cable, within the conduit, said apparatus comprising: generating means operative to generate a signal representative of a data message to be send; signal addition means operative to add said signal to the power waveform on the cables; separating means operative to separate said signal from the power waveform on the cables; decoding means operative to decode said separated signal; and reconstitution means, operative to reconstitute said data message.

33. An apparatus, according to claim 32, wherein said data message originates at said control station and is received at said device.

34. An apparatus, according to claim 32 or claim 33, wherein said data message originates at said device; and is received at said control station.

35. An apparatus, according to claim 34, including means to generate a first type of data message for sending instructions from said control station, and means to generate a second type of data message for sending reports from said device to said control station.

36. An apparatus, according to claim 35, further comprising: a plurality of tools, each in the vicinity of a respective device, in said conduit; at said control station, means to include, in said first type of data message, a device address portion indicative of the identity of the device to which an instruction is addressed; broadcast means, operative to send said first type of data message to all of the plurality of devices; device address decoding means operative to decode said device address portion at each of the plurality of devices; and response means, operative to cause a particular one of said plurality of devices to respond to the instruction only if the device address portion of the first type of data message is indicative of the first type of data message being addressed to that particular one of said plurality of devices.

37. An apparatus, according to claim 35, further comprising: a plurality of tools, each in the vicinity of a respective device, in said conduit; at said control station, means to include, in said first type of data message, a device address portion indicative of the identity of a plurality of addressed devices to which an instruction is addressed; broadcast means, operative to send said first type of data message to all of the plurality of devices; device address decoding means, operative to decode said device address portion at each of the plurality of devices; response means,

operative to cause all of said plurality of the addressed devices responding to the instruction.

38. An apparatus, according to claim 35, or according claim 36 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, comprising: a plurality of tools, each in the vicinity of a respective device, in said conduit; at any one of said devices, means to include, in said second type of data message, a report address portion indicative of the identity of the device from which a report originates; report address decoding means, operative to decode said report address portion at said control station; and attribution means, operative to attribute the report to that one of said plurality of devices indicated by the report address.

39. An apparatus, according to claim 35, according to claim 38, or according to claim 36 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, wherein a a device is operative to provide a second type of digital message without reception of a first type of digital message.

40. An apparatus, according to claim 35, 38 or 39, or according to claim 36 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, wherein a device, from among said plurality of devices, is operative to provide a report only after that particular device has received an instruction to provide a report.

41. An apparatus, according to any one of claims 35, 38, 39 or 40, or according to claim 34 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, wherein said second type of digital message comprises diagnostic data.

42. An apparatus, according to any one of claims 35, 38, 39 or 40, or according to claim 36 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, wherein said second type of digital message comprises data for tuning the apparatus.

43. An apparatus, according to any one of claims 35, 38, 39 or 40, or according to claim 36 or claim 37 when claim 36 or claim 37 is dependent upon claim 35, wherein said second type of digital message comprises data indicative of a reading from a sensor.

44. An apparatus, according to any one of claims 32 to 43, comprising means to include, in each sent each data message, an error detection portion containing error detection information; and further comprising examination means operative to examine said error detection portion in each received data message and to determine the digital integrity of the message.

45. An apparatus, according to claim 44, wherein said error detection portion comprises error detection information capable of allowing for correction of one or more errors.

46. An apparatus, according to claim 44 or claim 45, wherein said error detection information includes a checksum.

47. An apparatus, according to any one of claims 32 to 46, where said cable comprises at least two phases, and where said signal addition means is operative to add said signal to at least one of said phases.

48. An apparatus, according to any one of claims 32 to 47, wherein said cable is a three phase cable, operative to power the tool within the conduit said apparatus further comprising: a star point in the vicinity of the tool; and means to couple signals from the control station to said device and signals from said device to the control station through said star point.

49. An apparatus, according to claim 48, wherein said star point comprises junction of the three phase cables after passage through the tool

50. An apparatus, according to claim 48 or claim 49, further comprising: a power supply for said device; means to couple the

power supply to at least one of the three phase cables; and means to couple the power supply to said device via the star point.

51. An apparatus, according to any one of claims 32 to 50, wherein said conduit is the well bore within a hydrocarbon production well and wherein said control station is a surface station.

52. An apparatus, according to any one of claims 32 to 51, further comprising: a common ground; means to ground said device to said common ground; and means to ground the control station to said common ground.

53. An apparatus, according to claim 52 wherein said common ground comprises a conductive element within the well bore.

54. An apparatus, according to claim 53, wherein said conductive element comprises well bore casing.

55. An apparatus, according to claim 53, wherein said conductive element comprises tubing extending in said well bore.

56. An apparatus, according to any one of claims 32 to 55, wherein said signal representative of a data message, is a frequency shift keyed signal.

57. An apparatus, according to claim 56, including means to separate the frequency shift keyed signal from the power waveform on the cable comprising one or more frequency filters.

58. An apparatus, according to claim 57, wherein said one or more frequency filters includes at least one of: a low pass filter; a high pass filter; and a band pass filter.

59. An apparatus, according to any one of claims 56, 57 or 58, further comprising tuning means: said tuning means being operative to select one set of frequencies for said frequency shift keyed

signal; said tuning means being operative to transmit a test message using said one set of frequencies; if said transmission of said test message is adequate, said tuning means being operative to retain said one set of frequencies as operating frequencies; and if said transmission of said test message is inadequate, said tuning means being operative to select a another set of frequencies as said one set of frequencies.

60. An apparatus, according to claim 59, wherein said tuning means is operative to select a first spaced pair of frequencies as said one set of frequencies; and wherein said tuning means is operative to select a second spaced pair of frequencies, spaced from said first spaced pair of frequencies, as said another set of frequencies.

61. An apparatus, according to claim 60, wherein said second spaced pair of frequencies is higher in frequency than said first spaced pair of frequencies.

62. An apparatus, according to claim 60, wherein said second spaced pair of frequencies is lower in frequency than said first spaced pair of frequencies.